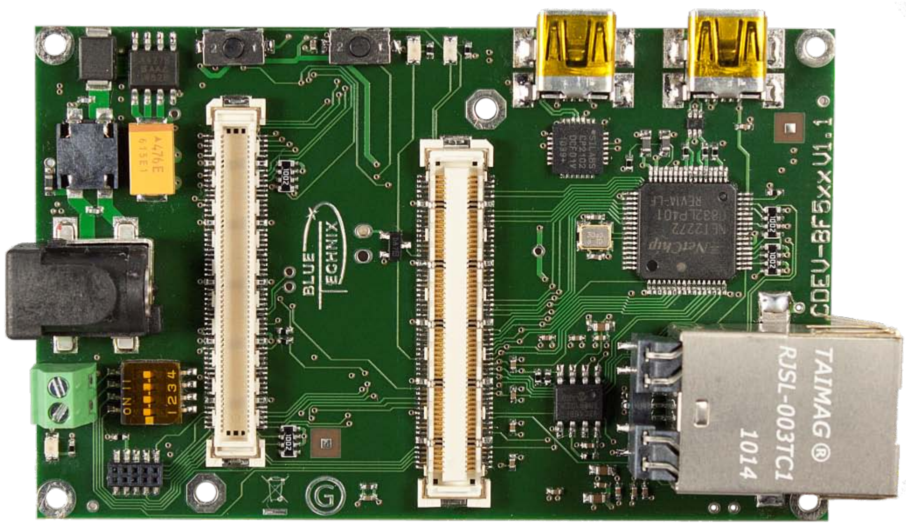


Hardware User Manual

CDEV-BF5xx V1.1

...maximum performance at minimum space

Contact

Bluetechnix Mechatronische Systeme GmbH

Waidhausenstraße 3/19

A-1140 Vienna

AUSTRIA/EUROPE

office@bluetechnix.at

http://www.bluetechnix.com

Document No.: 100-2350-1-1.3

Date: 2011-07-19

Table of Contents

The information herein is given to describe certain components and shall not be considered as a guarantee of characteristics.

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Bluetechnix takes no liability for any damages and errors causing of the usage of this board. The user of this board is responsible by himself for the functionality of his application. He is allowed to use the board only if he has the qualification. More information is found in the General Terms and Conditions (AGB).

Information

For further information on technology, delivery terms and conditions and prices please contact Bluetechnix (http://www.bluetechnix.com).

Warning

Due to technical requirements components may contain dangerous substances.

Blackfin® Core Modules

TCM-BF518-C-C-Q25S32F2 (TCM-BF518)

The Tiny Core Module TCM-BF518 is powered by Analog Devices' single core ADSP-BF518 processor; up to 400MHz, 32MB SDRAM, up to 8MB flash. The 2x60 pin expansion connectors are backwards compatible with other Core Modules.

ACM-BF525C-C-C-Q25S64F4N1024

The Core Module ACM-BF525C is optimized for audio applications and performance. It is based on the high performance ADSPBF525Cfrom Analog Devices. It addresses 64MByte SDRAM via its 16bit wide SDRAM bus, has an onboard NOR-flash of 4MByte and a NAND-flash with 1024MByte.

CM-BF527-C-C-Q50S32F8 (CM-BF527)

The Core Module CM-BF527 is powered by Analog Devices' single core ADSP-BF527 processor; key features are USB OTG 2.0 and Ethernet. The 2x60 pin expansion connectors are backwards compatible with other Core Modules.

CM-BF533-C-C-Q25S32F2 (CM-BF533)

The Core Module CM-BF533 is powered by Analog Devices' single core ADSP-BF533 processor; up to 600MHz, 32MB SDRAM, 2MB flash, 2x60 pin expansion connectors at a size of 36.5x31.5mm.

TCM-BF537-C-I-Q25S32F8 (TCM-BF537)

The Tiny Core Module TCM-BF537 is powered by Analog Devices' single core ADSP-BF537 processor; up to 500MHz, 32MB SDRAM, 8MB flash, a size of 28x28mm, 2x60 pin expansion connectors, Ball Grid Array or Border Pads for reflow soldering, industrial temperature range -40°C to +85°C.

CM-BF537-C-C-Q25S32F4 (CM-BF537E)

The Core Module CM-BF537 is powered by Analog Devices' single core ADSP-BF537 processor; up to 600MHz, 32MB SDRAM, 4MB flash, integrated TP10/100 Ethernet physical transceiver, 2x60 pin expansion connectors at a size of 36.5x31.5mm.

CM-BF537-C-C-Q30S32F4-U (CM-BF537U)

The Core Module CM-BF537 is powered by Analog Devices' single core ADSP-BF537 processor; up to 600MHz, 32MB SDRAM, 4MB flash, integrated USB 2.0 Device, 2x60 pin expansion connectors at a size of 36.5x31.5mm.

CM-BF548-C-C-Q25S64F8 (CM-BF548)

The Core Module CM-BF548 is characterized by its numerous peripheral interfaces, its performance in combination with its high speed memory interface (DDR). Key features are 533MHz, 64MB DDR SD-RAM (266MHz), and 8MB flash.

CM-BF561-C-C-Q25S64F8 (CM-BF561)

The Core Module CM-BF561 is powered by Analog Devices' dual core ADSP-BF561 processor; up to 2x 600MHz, 64MB SDRAM, 8MB flash, 2x60 pin expansion connectors at a size of 36.5x31.5mm.

eCM-BF561-C-C-Q25S128F32 (eCM-BF561)

The Core Module CM-BF561 is powered by Analog Devices' dual core ADSP-BF561 processor; up to 2x 600MHz, 128MB SDRAM, 8MB flash, 2x100 pin expansion connectors and a size of 44x33mm.

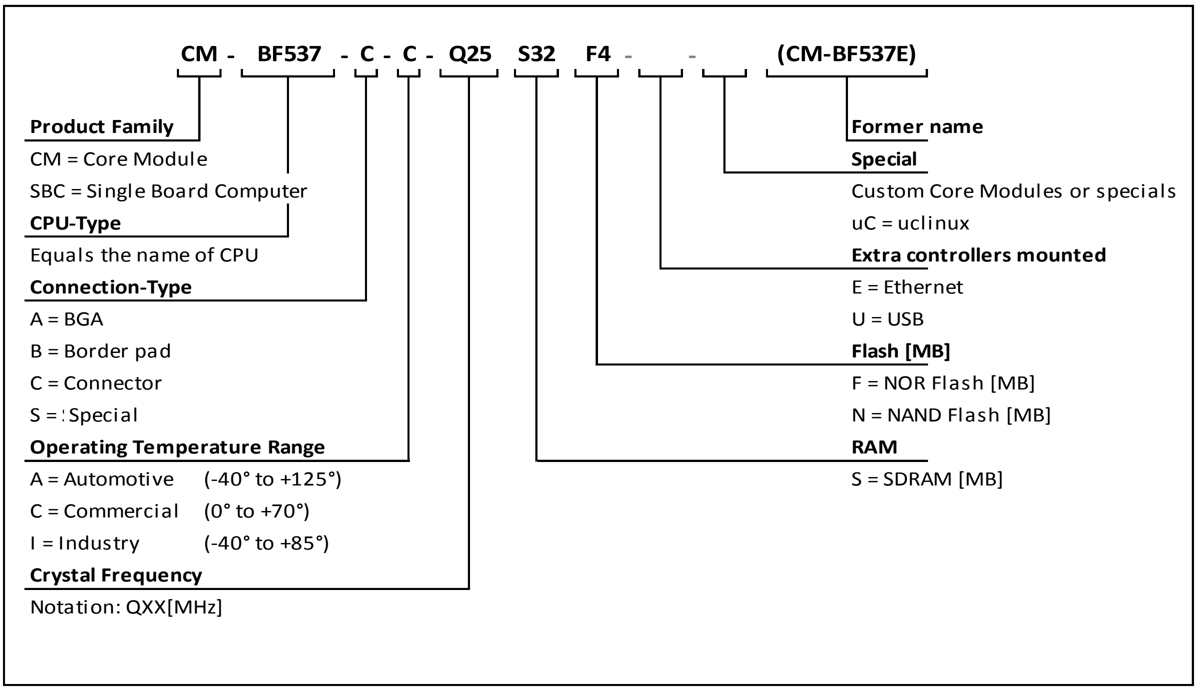
Core Module naming information

The idea is to put more Core Module specific technical information into the product name. New Core Module names will have following technical information covered in their names.

- Product Family,
- CPU-Type,
- Connection-Type,
- Operating Temperature Range,
- Crystal Frequency [MHz],
- RAM [MB],
- Flash [MB],
- External Controllers
- Optional
  - Special and/or
  - Former name

That expands of course the name but allows the customer to get the most important Core Module specific information at the first sight. Have a look at the example below to get an idea of the new Core Module names.

Example CM-BF537-C-C-Q25S32F4 (CM-BF537E)



Blackfin® Development Boards

ADEV-BF52xC

Feature rich, low cost embedded audio development platform which supports Audio Core Modules (ACM). The form factor of the ADEV-BF52xC allows easy integration of the board into OEM products. Dedicated interfaces such as USB2.0, Line In/Out, headphone out and an onboard silicon microphone turn the ADEV-BF52xC into a full-featured development platform for most embedded audio applications in commercial areas.

DEV-BF5xxDA-Lite

Get ready to program and debug Bluetechnix Core Modules with this tiny development platform including an USB-Based Debug Agent. The DEV-BF5xxDA-Lite is a low cost starter development system including a VDSP++ Evaluation Software License.

DEV-BF548-Lite

Low-cost development board with a socket for Bluetechnix' CM-BF548 Core Module. Additional interfaces are available, e.g. an SD-Card, USB and Ethernet.

DEV-BF548DA-Lite

Get ready to program and debug Bluetechnix CM-BF548 Core Module with this tiny development platform including an USB-Based Debug Agent. The DEV-BF548DA-Lite is a low-cost starter development system including a VDSP++ Evaluation Software License.

eDEV-BF5xx

Feature rich, low cost rapid development platform which provides all interfaces on dedicated connectors and has all Core Module pins routed to solder pads which easily can be accessed by the developers. The eDEV-BF5xx supports the latest debugging interface from Analog Devices - ADI-SADA (Analog Devices Stand Alone Debug Agent).

EVAL-BF5xx

Tiny, low cost embedded platform which supports Bluetechnix powerful Blackfin® based Core Modules. The form factor (75x75mm) of the EVAL-BF5xx allows easy integration of the board into OEM products. Dedicated interfaces such as USB2.0, SD-card slot, CAN interface connectors and of course Ethernet, turn the EVAL-BF5xx into a full-featured evaluation platform for most embedded applications.

Extender boards

Extender boards (EXT-BF5xx) are expanding the development and evaluation boards by several interfaces and functionalities. Targeted application areas are: audio/video processing, security and surveillance, Ethernet access, positioning, automation and control, experimental development and measuring.

Note! Bluetechnix is offering tailored board developments as well.

1 Introduction

The CDEV-BF5xx Development Board is a feature rich, low cost industrial camera development platform which supports Bluetechnix latest powerful Blackfin® based Core Modules e.g. the eCM-BF561. Based on Bluetechnix' long experience in industrial and commercial embedded systems design, this board is suited to the market requirements to decrease time-to-market of your industrial applications. The form factor of CDEV-BF5xx allows easy integration of the board into OEM products. Dedicated interfaces such as Ethernet, CAN, USB2.0 and a micro SD-Card slot turn the CDEV-BF5xx into a full-featured development platform for most industrial and commercial camera applications.

1.1 Overview

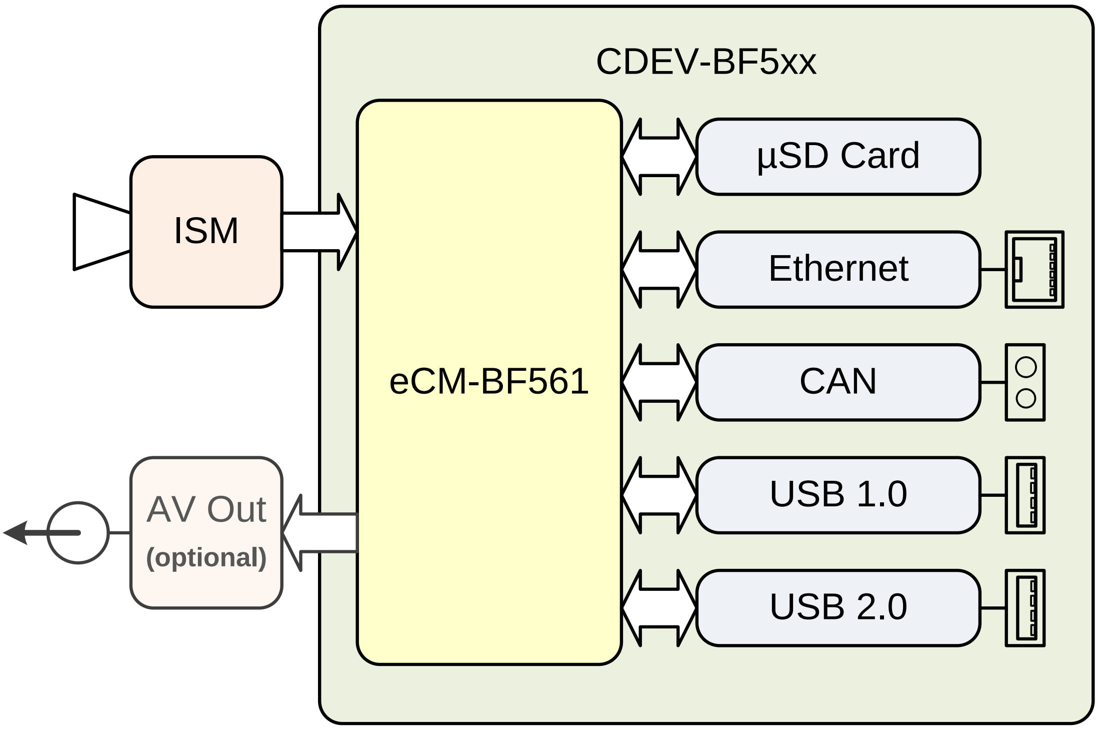


Figure 1-1: CDEV-BF5xx overview

1.2 Key Features

- **eCM-BF561 Core Module Slot**
  - Mating with eCMBF561 Core Module
  - Two mounting holes allow fixing the Core Module with two M2 screws
- **USB to UART converter**
  - SiLabs CP2102 USB to UART Bridge
  - Mini USB-B Connector
- **USB 2.0 Device Controller**
  - PLX Technology NET2272 USB Device Controller
  - Mini USB-B Connector
- **Ethernet Controller**
  - SMSC LAN9218 Ethernet Controller

- RJ45 Connector with 2 LEDs
- 93C46B/SN EEPROM for MAC storage

- **Power Supplies**
  - DC-Plug
  - On-board DC-DC converter allows connecting unregulated power supply between 7V and 24V
  - 3.3V switching supply for all devices
  - 2.85V analog and IO voltage for Image Sensor Modules (max. 300mA)
- **Camera Connector (BLT-ISM-Connector)**
  - 30 pin ZIF connector
  - Compatible with all Bluetechnix Image Sensor Modules
- **µSD-Card Slot**
  - Compatible with µSD-Cards
  - SPI interface
- **LEDs**
  - 1 power LED
  - LEDs (red and green) on GPIOs
- **Button**
  - RESET Button
  - 1 Button on GPIO
- **Optional CAN Controller**
  - MCP2515-I/ST CAN Controller
- **Optional Analog Video (AV) Adapter**
  - eADP-AV-Out to enable analog video out

1.3 Applications

- Machine Vision
- Environment Observation
- Home Automation
- Video Streaming
- Image Recognition
- Video Surveillance
- Object Counting
- Scientific Imaging
- Industrial and commercial applications

2 General Description

The CDEV-BF5xx is designed to cover the needs for an intelligent image sensor with a high flexibility in data transmission. The typical workflow can be divided in three actions:

- Data capturing
- Video/Image processing
- Data transmission

The Bluetechnix standard Image Sensor Interface (BLT-ISM-Connector) allows connecting various image sensors to the CDEV-Bf5xx (i.e. ISM-MT9M024, ISM-MT9M131 or ISM-MT9P031). All have a compliant 30 pin ZIF connector; the software drivers are included at BLACKSheep® OS and the CDK board support package (BSP).

The eCM-BF561, incorporating the Blackfin® 561 dual core signal processor, is predestinated for image and video processing applications, like filtering object tracking, video compressing, etc. Even the Core Modules with single core processors can be used by a suitable eADP Core Module adapter (eADP-USB, eADP-ETH).

To transmit the captured and processed data there are various interfaces on the CDEV-BF5xx. Depending on the needed transmission rate you can select between USB, Ethernet, CAN (optional) or just store the data on a micro-SD-card. The proper drivers are included at BLACKSheep® OS and the CDK board support package (BSP).

If there is the need to visualize the processed data or simply for visual debugging, an analog video output adapter (eADP-AV-Out) is available. This adapter generates a PAL or NTSC CVBS video signals.

2.1 Functional Description

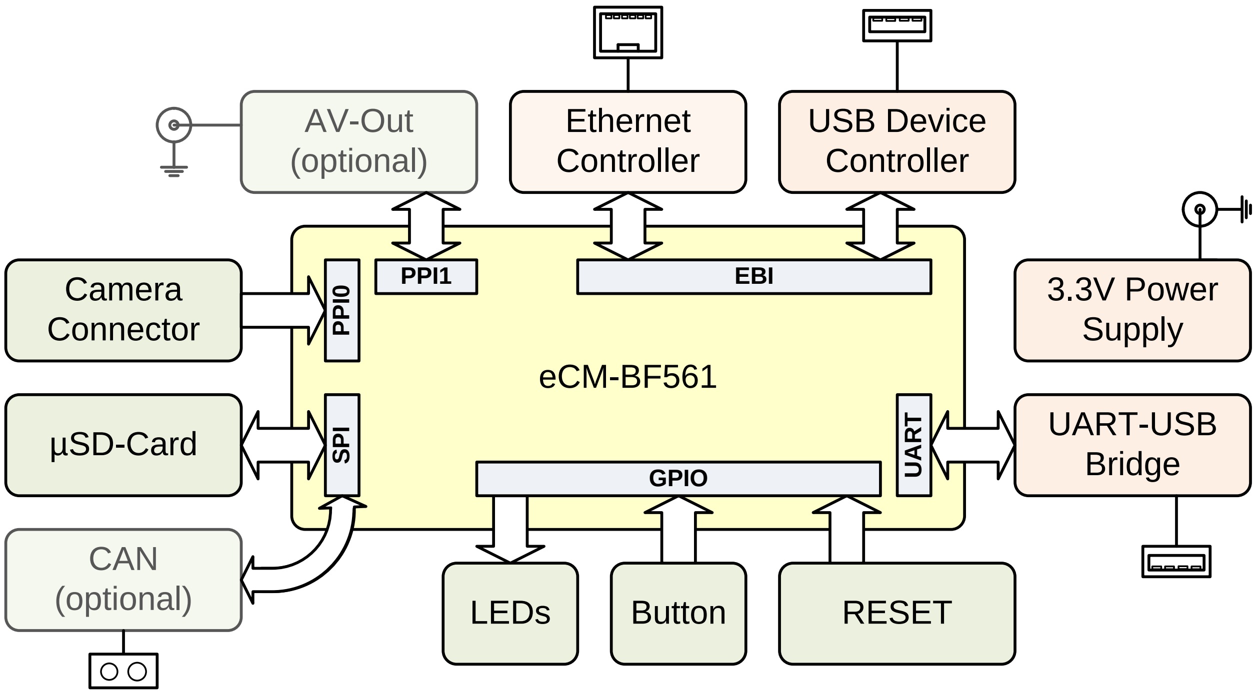


Figure 2-1: Functional overview

2.1.1 Powering

An on-board DC/DC converter allows connecting unregulated power supply between 7V and 24V. The regulator generates the 3.3V power supply needed for all components as well as the 2.85V for the ISMs.

2.1.2 USB

There are two USB interfaces on the CDEV-BF5xx. The CP2102 UART to USB bridge from SiLabs is usable for slow data rates and debugging messages; the USB V2.0 compliant NET2272 controller from PLX Technology allows communicating with higher bandwidth.

The NET2272 is connected to the Blackfins EBI (External Bus Interface) and is accessible by asserting the AMS2 Signal. Asserting the GPIO PF13 sets the controller in RESET state. For more details see the GPIO connection table and the memory mapping table.

2.1.3 Ethernet

The LAN9218 from SMSC is a 10/100 Base-T Ethernet controller with an integrated HP Auto-MDIX PHY. The controller is connected to the EBI and is accessible by asserting the AMS1 signal. The device-reset is connected to the global board reset. For more details see the GPIO Connection table and the Memory Mapping table.

2.1.4 µSD-Card

The micro-SD-card slot is connected to the SPI bus interface (shared with the optional CAN controller). A 4-bit parallel mode is not supported.

2.1.5 CAN (optional)

As an mounting option the MCP2515-I/ST CAN controller can be connected to the SPI bus interface. If both, SD-card and CAN are used, be sure to check, if the bandwidth is sufficient.

The SN65HVD232D CAN bus transceiver generates the CAN+ and CAN- signals with the defined voltage levels. A termination resistor is designed in, but not populated. If the resistor is needed, you can either add a wired 120Ω resistor externally, or solder the R22 SMD resistor (0402 package) next to the CAN terminal.

2.1.6 Image Sensor Connector (BLT-ISM-Connector)

The Bluetechnix Image-Sensor-Connector "BLT-ISM-Connector" is a Bluetechnix standardized interface with 30 pins, which allows easy connection of the Bluetechnix Image-Sensor-Modules to the development and extender boards from Bluetechnix.

Advantages of the BLT-ISM-Connector

- one interface for all Image-Sensor-Modules
- flexible, camera is not fixed on the baseboard
- single power supply

The data and control lines are connected to the PPI0 bus. Pixel and master clock are generated by the ISMs. The configuration bus is connected to GPIO pins (PF46 and PF45 for the ADSP-BF561). The I²C protocol has to be emulated with the GPIOs (available drivers can be found at CDK BSP or BLACKSheep® OS).

2.1.7 Analog Video Out

There is the possibility to stack the eADP-AV-Out adapter between the Core Module and the development board. This adapter loops through all pins, except the PPI1 signals. They are connected to the **ADV7391** video encoder from Analog Devices. This adapter is only usable for the eCM-BF561 because of the absence of the PPI1 interface on other Core Modules. For further details please refer the hardware user manual of the eADP-AV-Out.

2.2 PCB Placement

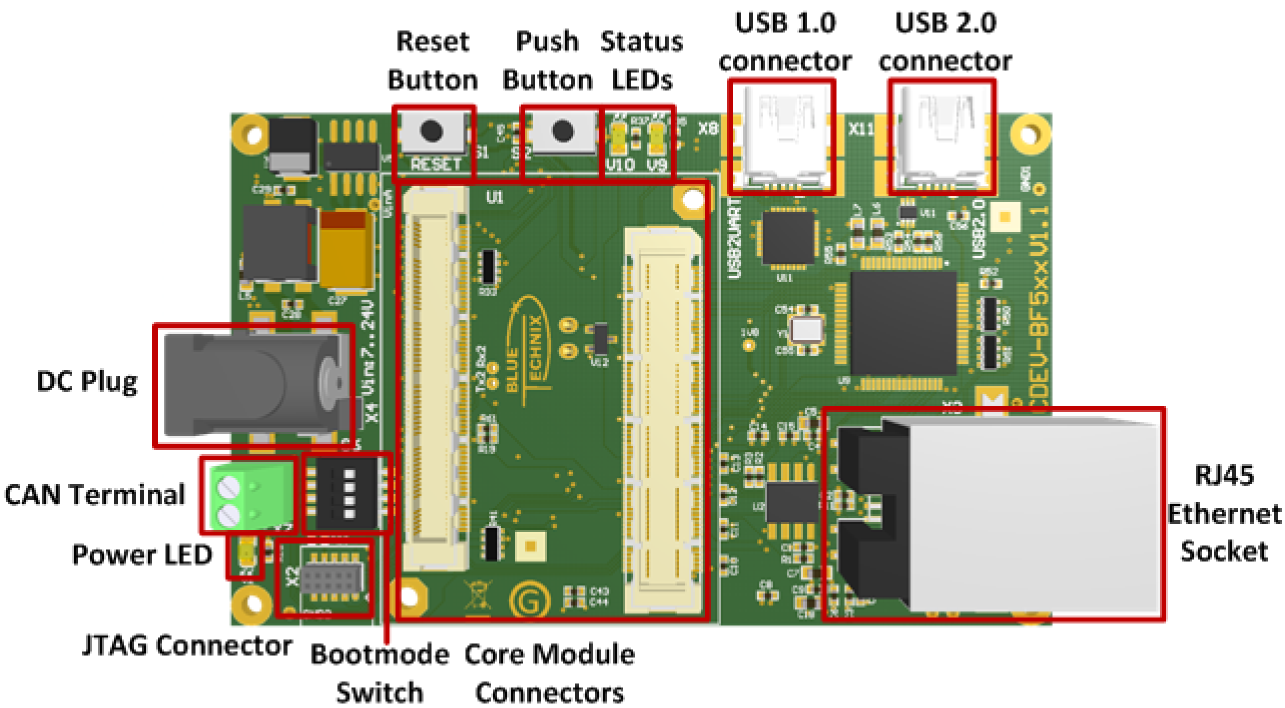


Figure 2-2: Top component placement

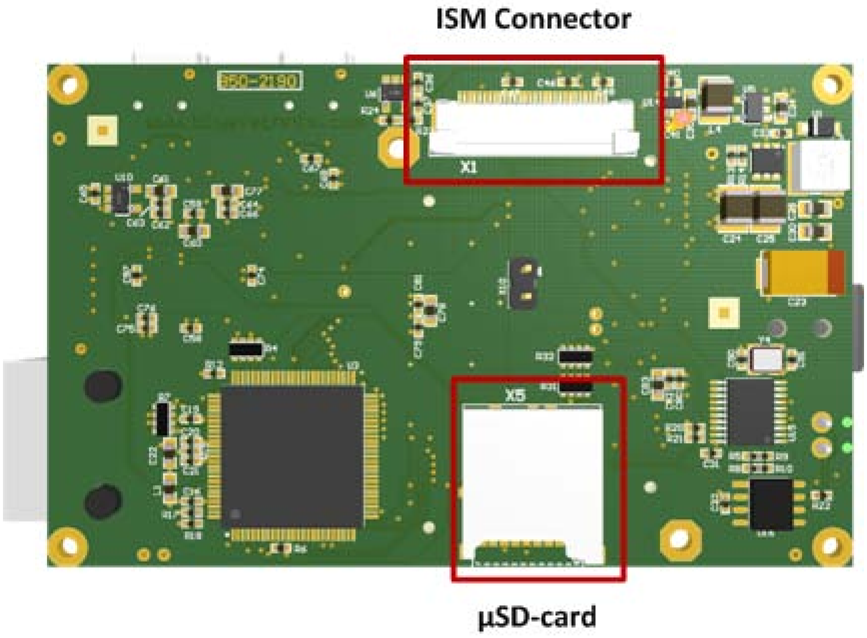


Figure 2-3: Bottom component placement

2.3 Mechanical Outline

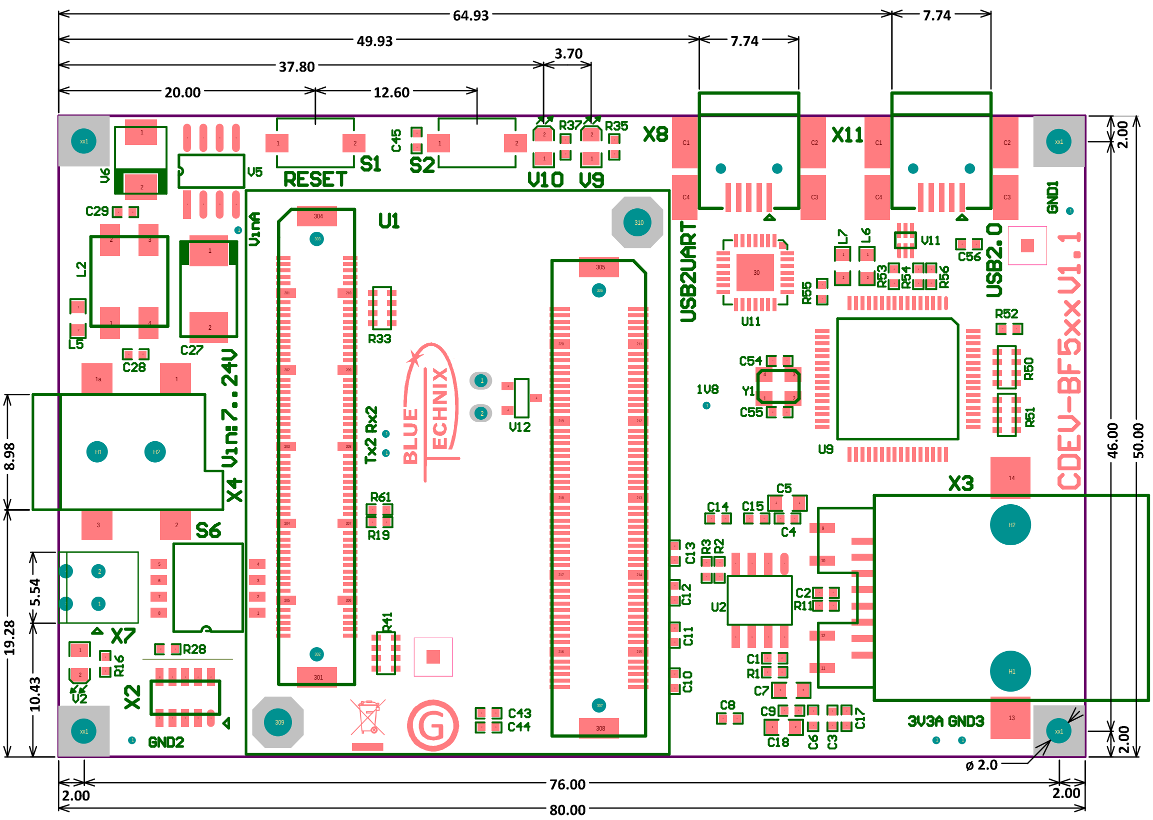


Figure 2-4: Board layout – top layer

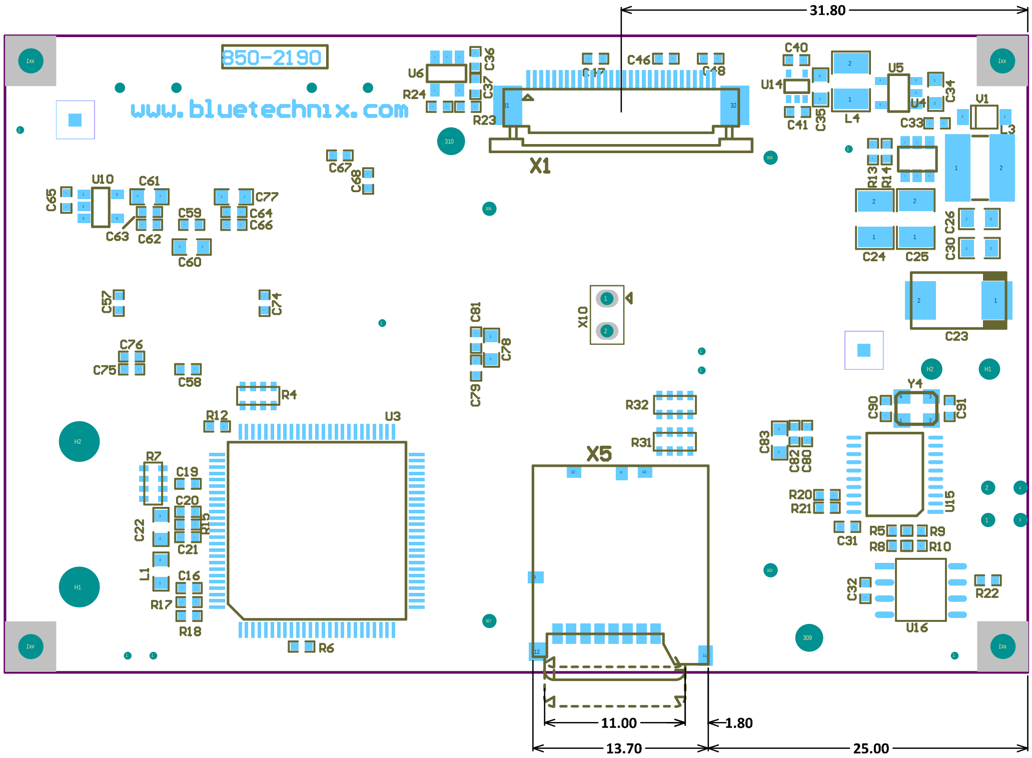


Figure 2-5: Board layout– bottom layer

3 Specifications

3.1 Electrical Specifications

3.1.1 Operating Conditions

Symbol	Parameter	Min	Typical	Max	Unit
V_{IN}	Input supply voltage	7		24	V
P	Power consumption (using eCM-BF561 and ISM-MT9M024C)	TBD	TBD	TBD	mW
V_{CAMA}, V_{CAMIO}	Analog and I/O Voltage Supply for the ISM		2.87		V
V_{CAMC}	ISM Core Voltage Supply		1.8		V
$I_{2.87}$				300	mA
$I_{1.8}$				500	mA

Table 3-1: Electrical characteristics

3.1.2 Maximum Ratings

Stressing the device above the rating listed in the absolute maximum ratings table may cause permanent damage to the device. These are stress ratings only. Operation of the device at these or any other conditions greater than those indicated in the operating sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

Symbol	Parameter	Min	Max	Unit
V_{IO}	Input or output voltage	-0.5	3.6	V
V_{IN}	Input supply voltage	-0.5	24	V
I_{OH} /I_{OL}	Current per pin	0	10	mA
T_{AMB}	Ambient temperature	-40	85	°C
T_{STO}	Storage temperature	-55	150	°C
T_{SLD}	Solder temperature for 10 seconds		260	°C
φ_{AMB}	Relative ambient humidity		90	%

Table 3-2: Absolute maximum ratings

3.1.3 ESD Sensitivity



ESD (electrostatic discharge) sensitive device. Charged devices and circuit boards can discharge without detection. Although this product features patented or proprietary protection circuitry, damage may occur on devices subjected to high energy ESD. Therefore, proper ESD precautions should be taken to avoid performance degradation or loss of functionality.

4 Connector Description

4.1 BLT-ISM-Connector (X1)

Pin No.	ISM Signal	Type	Connected BF561 Pin	Description
1	nOE	O	-	Output enable (active low)
2	D11	I	PPI0.D11	Pixel Data 11
3	D10	I	PPI0.D10	Pixel data 10
4	D9	I	PPI0.D9	Pixel data 9
5	D8	I	PPI0.D8	Pixel data 8
6	GND	PWR	GND	Power ground
7	D7	I	PPI0.D7	Pixel data 7
8	D6	I	PPI0.D6	Pixel data 6
9	D5	I	PPI0.D5	Pixel data 5
10	D4	I	PPI0.D4	Pixel data 4
11	GND	PWR	GND	Power ground
12	VCAM	PWR	-	2.85V supply
13	D3	I	PPI0.D3	Pixel data 3
14	D2	I	PPI0.D2	Pixel data 2
15	D1	I	PPI0.D1	Pixel data 1
16	D0	I	PPI0.D0	Pixel data 0
17	STROBE	I	PF45	Strobe signal from camera
18	TRIGGER	O	PF44	Camera trigger
19	HSYNC	I	PPI0.SY1	Horizontal frame synchronization
20	VSYNC	I	PPI0.SY2	Vertical frame synchronization
21	CLK	I	PPI0.CLK	Pixel Clock
22	GND	PWR	-	Power Ground
23	VCAMC	PWR	-	Camera core voltage supply (connected to 1.8V, but not used for ISMs)
24	SDA	I/O	PF46	Configuration bus data line
25	SCL	O	PF47	Configuration bus clock line
26	nRESET	O	RESET	Global board reset (active low)
27	EXTCLK	O	CLKBUF	Mount Option instead of onboard oscillator
28	SADDR	NC	-	Not connected
29	GND	PWR	-	Power ground
30	VCAM	PWR	-	2.85V power supply

Table 4-1: BLT-ISM-Connector interface description (X1)

4.2 JTAG Connector (X2)

Pin No.	Signal Name	Type	Description
1	TDO	O	Test Data Output
2	TDI	I	Test Data Input
3	TCK	I	Test Clock
4	TMS	I	Test Mode Selection
5	TRST	I	Test Reset (active low)
6	EMU	O	Emulation (active low)
7	GND	PWR	Power Ground
8	Vref	Passive	IO Reference Voltage (10kΩ resistor to 3.3V)
9	GND	PWR	Power Ground

Pin No.	Signal Name	Type	Description
10	GND	PWR	Power Ground

Table 4-2: Connector description X2

4.3 CAN Terminal (X7)

Pin No.	Signal Name	Type	Description
1	CAN +	I/O	Positive CAN signal
2	CAN -	I/O	Negative CAN Signal

Table 4-3: Connector description X7

4.4 RTC Supply Pins (X10)

The RTC supply work for all available Blackfin based Core Modules except the eCM-BF561 and CM-BF561, because the ADSP-BF561 has no integrated real time clock. If another Core Module is used (in combination with an eADP), the RTC power domain is normally powered by the internal 3.3V. If the RTC is needed to be kept alive when the board is unpowered, there is the possibility to connect a battery to these pins.

Pin No.	Signal Name	Type	Description
1	VDD	I/O	RTC supply
2	GND	I/O	Power Ground

Table 4-4: Connector description X10

5 Switches, Jumpers and LEDs

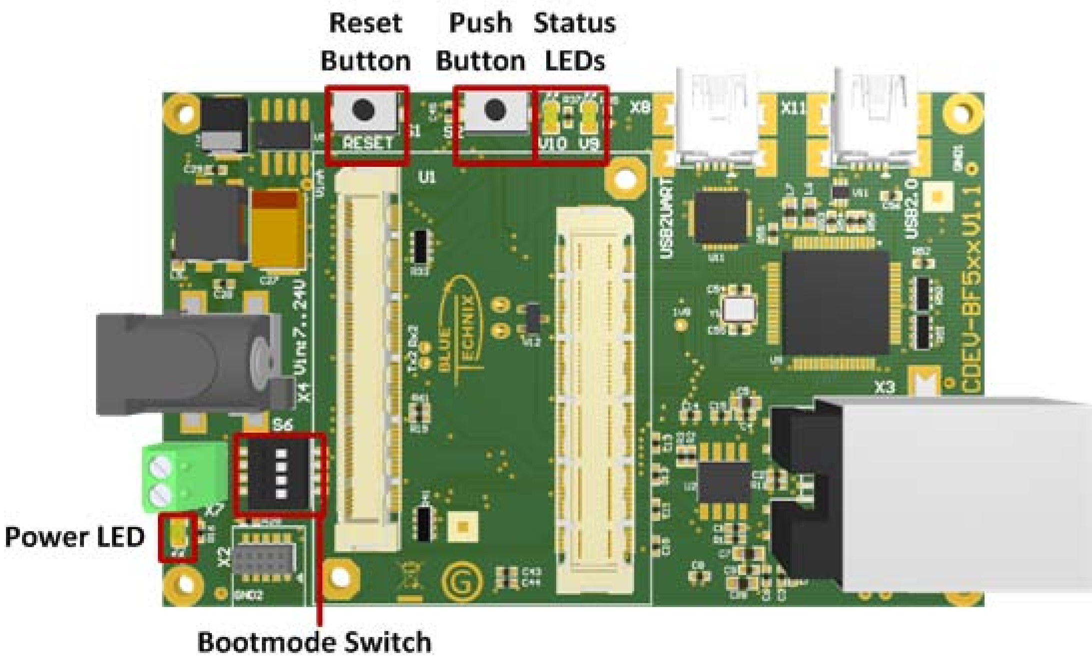


Figure 5-1: LEDs buttons and switch position

5.1 Power LED V2

The Power LED V2 indicates that the power is plugged in and the 3.3V supply is generated.

5.2 Status LEDs V9, V10

The two Status LEDs V9 and V10 are connected to GPIOS and can be used to indicate the actual program state.

LED	Color	Connected BF561 GPIO
V9	red	PF6
V10	green	PF7

Table 5-1: Status LEDs connection description

5.3 GPIO Button S2

The GPIO button S2 is connected to the BF561 GPIO Pin PF10.

5.4 Reset Button S1

The RESET Button resets all active components on the board including the Core Module.

5.5 Boot Mode Switch S6

To set the right boot mode for the eCM-BF561, only the switches 1 and 2 are used; switches 3 and 4 are used for extended boot mode features when using other Core Modules with the eADP adapter.

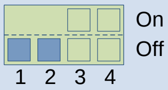
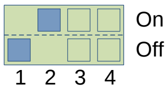
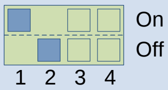
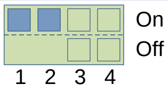
Switch Setting	Boot Description
	Execute from16Bit external memory bypass ROM
	Reserved
	Boot from 8Bit Flash
	Boot from SPI 16Bit

Table 5-2: Boot mode settings

6 Support

6.1 General Support

General support for products can be found at Bluetechnix' support site https://support.bluetechnix.at/wiki

6.2 Board Support Packages

Board support packages and software downloads are for registered customers only https://support.bluetechnix.at/software/

6.3 Blackfin® Software Support

6.3.1 BLACKSheep® OS

BLACKSheep® OS stands for a powerfully and multithreaded real-time operating system (RTOS) originally designed for digital signal processing application development on Analog Devices Blackfin® embedded processors. This high-performance OS is based on the reliable and stable real-time VDK kernel from Analog Devices that comes with VDSP++ IDE. Of course BLACKSheep® OS is fully supported by all Bluetechnix Core-Modules and development hardware.

6.3.2 LabVIEW

You can get LabVIEW embedded support for Bluetechnix Core Modules by Schmid-Engineering AG http://www.schmid-engineering.ch.

6.3.3 uClinux

You can get uClinux support (boot loader and uClinux) for Bluetechnix Core Modules at http://blackfin.uClinux.org.

6.4 Blackfin® Design Services

Based on more than seven years of experience with Blackfin, Bluetechnix offers development assistance as well as custom design services and software development.

6.4.1 Upcoming Products and Software Releases

Keep up to date with all product changes, releases and software updates of Bluetechnix at http://www.bluetechnix.com.

7 Ordering Information

The following table shows the ordering information for the CDEV-BF5xx and other related products.

Article Number	Name	Description
100-2350-1	CDEV-BF5xx	Camera development board for especially for the eCM-BF561
100-3106	CDK - Camera Development Kit	Including eCM-BF561, CDEV-BF5xx and ISM-MT9M024-Mono
100-1214-1	eCM-BF561-C-C-Q25S128F32 (eCM-BF561)	Commercial eCM-BF561 Core Module Connector Version (extended Memory)
100-1215-1	eCM-BF561-C-I-Q25S128F32 (eCM-BF561)	Industrial eCM-BF561 Core Module Connector Version (extended Memory)
100-7010-1	eADP-AV-Out	Analog Video Out Adapter
100-3200-1	ISM-MT9M024-Mono	Image Sensor Module ISM-MT9M024 Monochrome
100-3206-1	ISM-MT9M024-Color	Image Sensor Module ISM-MT9M024 Color
100-3208-1	ISM-MT9M024-RCCC	Image Sensor Module ISM-MT9M024 RCCC
100-3202-1	ISM-MT9M131-Color	Image Sensor Module ISM- MT9M131 Color
100-3204-1	ISM-MT9P031-Color	Image Sensor Module ISM- MT9P031 Color
100-3210-1	ISM-MT9P031-Mono	Image Sensor Module ISM- MT9P031 Mono

Table 7-1: Ordering information

NOTE: Custom hard and software developments are available on request! Please contact Bluetechnix (office@bluetechnix.com) if you are interested in custom hard- and software developments.

8 Dependability

8.1 MTBF

Please keep in mind that a part stress analysis would be the only way to obtain significant failure rate results, because MTBF numbers just represent a statistical approximation of how long a set of devices should last before failure. Nevertheless, we can calculate an MTBF of the development board using the bill of material. We take all the components into account. The PCB and solder connections are excluded from this estimation. For test conditions we assume an ambient temperature of 30°C of all development board components. We use the MTBF Calculator from ALD (http://www.aldservice.com/) and use the reliability prediction MIL-217F2 Part Stress standard. Please get in touch with Bluetechnix (office@bluetechnix.com) if you are interested in the MTBF result.

9 Product History

9.1 Version Information

Version	Date	Changes
1.1	2011 06 09	ISM connector rotated by 180°. ISM Voltage Regulation added for Analog and I/O supply
1.0	2010 12 03	First release V1.0 of the Hardware.

Table 9-1: Overview product changes

9.2 Anomalies

Version	Date	Description
1.1	2011 06 09	No anomalies reported yet.
1.0	2010 12 03	No anomalies reported yet.

Table 9-2: Overview product anomalies

10 Document Revision History

Version	Date	Document Revision
3	2011 07 19	Updated ISM connector and boot mode description, added products to order information.
2	2011 07 08	Updated ISM connector description, added products to order information.
1	2011 06 09	First release V1.0 of the Document

Table 10-1: Revision history

11 List of Abbreviations

Abbreviation	Description
ADI	Analog Devices Inc.
AI	Analog Input
AMS	Asynchronous Memory Select
AO	Analog Output
CM	Core Module
DC	Direct Current
DSP	Digital Signal Processor
eCM	Enhanced Core Module
EBI	External Bus Interface
ESD	Electrostatic Discharge
GPIO	General Purpose Input Output
I	Input
I^2C	Inter-Integrated Circuit
I/O	Input/Output
ISM	Image Sensor Module
LDO	Low Drop-Out regulator
MTBF	Mean Time Between Failure
NC	Not Connected
NFC	NAND Flash Controller
O	Output
OS	Operating System
PPI	Parallel Peripheral Interface
PWR	Power
RTOS	Real-Time Operating System
SADA	Stand Alone Debug Agent
SD	Secure Digital
SoC	System on Chip
SPI	Serial Peripheral Interface
SPM	Speech Processing Module
SPORT	Serial Port
TFT	Thin-Film Transistor
TISM	Tiny Image Sensor Module
TSC	Touch Screen Controller
UART	Universal Asynchronous Receiver Transmitter
USB	Universal Serial Bus
USBOTG	USB On The Go
ZIF	Zero Insertion Force

Table 11-1: List of abbreviations

A List of Figures and Tables

Figures

Tables